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Predicting Scaled Volume Recoverable from Cutover Southwestern Ponderosa Pine Stands

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Standard volume tables provide a means of estimating average gross volume per tree in standing timber. The gross volume actually recoverable from the timber may vary from estimated volume because of (1) differences between assumed volume table utilization standards and actual logging practices, (2) differences in form of timber, and (3) differences between stick-scaled and equation-calculated volumes. The tables presented provide a means of predicting scaled volume recoverable from cutover southwestern ponderosa pine stands on sites of low and intermediate quality.
KEY WORDS: Pinus ponderosa, tree increment estimates, tree volume tables.

Standard volume tables provide a means of estimating average gross volume per tree in standing timber. The gross volume actually recoverable from the timber may vary from estimated volume because of:

1. Differences between utilization practices and the utilization standards assumed in constructing the standard volume table;
2. Differences between the form of the timber and the average form represented by the standard volume table;
3. Differences between stick-scaled board-foot volume and volume calculated by equation (particularly where equation calculations are

in Scribner scale and stick-scale is in Scribner Decimal C).

The tables presented in this Note provide a means of predicting scaled volume recoverable from cutover southwestern ponderosa pine (Pinus ponderosa Laws.) stands on sites of low and intermediate quality.

The Sample and the Sampling Area

Sample trees were selected by establishing a series of randomly located 2-chain strips across a 450-acre clearcut sale area; all saw-timber trees within the strips were sample trees. A total of 1,565 sample trees 11 inches diameter breast high (d.b.h.) and larger were measured and scaled on the ground after felling.

Site index[2] on the study area ranged from 44 to 70, and averaged 56. The general form

[2] Meyer, Walter H. Yield of even-aged stands of ponderosa pine. U.S. Dep. Agr. Tech. Bull. 630. 59 p. (Revised.) 1961.

and character of the timber is reflected in the range of log height-diameter combinations included in the basic data (blocked out in tables 1-6). The area is representative of cutover ponderosa pine on low and intermediate sites, which support a large proportion of the regional timber resource.

Analysis Methods

Measurements of d.b.h., merchantable height, diameters inside bark at stump and at each log height, and board-foot scale were obtained for each sample tree. Gross Scribner Decimal C scale was determined for each 16.5-foot saw log in the tree, and for top half-logs where present, to a variable minimum merchantable diameter. Most blackjack ponderosa pine trees can be utilized to the minimum saw log merchantability limit specified, usually 8 inches. Minimum merchantable diameter in old-growth timber, however, is more often governed by top branching characteristics than by diameter.

Gross cubic-foot volume was determined for each log and half-log in sample trees by applying the formula for volume of a frustum of a cone to individual half-log stem sections.

Tables of predicted gross board-foot and cubic-foot volume recovery were developed by means of the combined variable regression model: [3]

$$V = a + b D^2 H$$
where
V = gross recoverable volume
D = d.b.h., outside bark, in inches
H = merchantable height, in logs
a and b = constants

Tree Height Conversion

All tables of recoverable volume are based on merchantable tree height in 16-foot logs and half-logs. Where total tree height measurements are available instead, they can be converted to log heights with the following tabulation or equation, covering both old-growth and blackjack trees:

Total tree height (Feet)	Estimated height in 16-foot logs (Number)
31	0.5
38	1.0
45	1.5
53	2.0
60	2.5
67	3.0
74	3.5
82	4.0

Height in 16-foot logs can be estimated directly for both blackjack and old-growth trees by the equation: [4]

$$Y = 0.069X - 1.63$$
where
Y = number of 16-foot logs
X = total tree height, in feet

The Tables

Tables of recoverable volume are presented for both board-foot and cubic-foot volumes in blackjack and old-growth ponderosa pine. Some users prefer volume data based on full inch classes (for example 20.0-20.9), while others prefer diameter classes that break on the half inch (e.g., 19.6-20.5). Tables are provided for both systems.

[3] Husch, Bertram. Forest mensuration and statistics. 474 p. New York: The Ronald Press. 1963.

[4] Regression based on subsample of 74 trees.

Table 1.--Gross scaled volumes in board feet Scribner rule, cutover blackjack ponderosa pine

Board feet inside bark
Merchantable stem excluding stump and top

Top diameter variable
Stump height 1.0 foot

DBH class (Inches)	Number of merchantable 16-foot logs							Basis: Trees
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	
Midpoint at full inch:[1]				Volume in board feet				Number
11.0	14	26	38	51	63	75	88	193
12.0	16	31	45	60	75	89	104	182
13.0	19	36	53	70	87	105	122	104
14.0	21	41	61	81	101	121	141	63
15.0	24	47	70	93	116	139	162	35
16.0	28	54	80	106	132	158	184	19
17.0	31	60	90	119	148	178	207	15
18.0	34	67	100	133	166	199	232	10
19.0		75	112	148	185	222	258	3
20.0		83	123	164	205	245		1
21.0		91	136	181	226			1
22.0			149					0
Midpoint at half-inch:[2]								
11.5	15	28	42	55	69	82		86
12.5	17	33	49	65	81	97	113	206
13.5	20	39	57	76	94	113	131	138
14.5	23	44	66	87	108	130	151	88
15.5	26	50	75	99	124	148	172	45
16.5	29	57	85	112	140	168	195	25
17.5	33	64	95	126	157	188	219	20
18.5	36	71	106	141	175	210	245	8
19.5	40	79	117	156	195	233	272	8
20.5		87	130	172	215	258		0
21.5		95	142	189	236	283		2
22.5			156		259			0
Basis: No. trees	3	100	254	197	61	10	1	626

Block indicates extent of basic data.
Derived from $V = 1.5469 + 0.2032\, D^2 H$.
Standard error of estimate = ± 21.81 percent.
[1] Diameter class breaks at half-inch: e.g., 20-inch class includes 19.6 to 20.5.
[2] Diameter class breaks at full inch: e.g., 20-inch class includes 20.0 to 20.9.

Table 2.--Gross scaled volumes in board feet Scribner rule, cutover
old-growth ponderosa pine

Board feet inside bark　　　　　　　　　　　　　　　　　　Top diameter variable
Merchantable stem excluding stump and top　　　　　　　Stump height 1.0 foot

DBH class (Inches)	Number of merchantable 16-foot logs										Basis: Trees
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
Midpoint at full inch:[1]	- - - - - - - - - - - Volume in board feet - - - - - - - - - - -										Number
11.0	15	29	43	57	72						10
12.0	18	35	51	68	85	102					19
13.0	21	40	60	80	100	119	139				34
14.0	24	47	70	93	115	138	161				38
15.0	27	54	80	106	132	159	185	211			49
16.0	31	61	91	121	151	180	210	240			80
17.0	35	68	102	136	170	204	237	271	305		102
18.0	39	77	115	152	190	228	266	304	342		101
19.0	43	85	127	170	212	254	296	339	381		105
20.0	48	94	141	188	235	281	328	375	422		71
21.0	52	104	156	207	259	310	362	413	465		88
22.0	57	114	171	227	284	340	397	454	510		59
23.0	63	125	186	248	310	372	434	496	557		52
24.0	68	136	203	270	338	405	472	540	607	674	45
25.0		147	220	293	366	439	512	585	658	732	25
26.0		159	238	317	396	475	554	633	712	791	27
27.0		171	257	342	427	512	597	683	768	853	13
28.0			276	367	459	551	642	735	826	917	2
29.0			296	394	492	591	689	787	886	984	2
30.0			317	422	527	632	737	843	948	1053	6
31.0				450	563	675	787	900	1012	1124	2
32.0				480	599	719	839	959	1078	1198	3
33.0				510	637	765	892	1019	1147	1274	2
34.0				541	677	812	947	1082	1217		0
35.0				574	717	860	1003	1147	1290		1
36.0				607	758	910	1061	1213	1364		1
37.0					801		1121	1281	1441		2
38.0								1351			0
Basis: No. trees	8	57	145	270	213	150	57	35	3	1	939

Block indicates extent of basic data.
Derived from $V = 0.8969 + 0.2338\ D^2H$.
Standard error of estimate = ± 27.19 percent.
[1] Diameter class breaks at half-inch: e.g., 20-inch class includes 19.6 to 20.5.

Table 3.--Gross scaled volumes in board feet Scribner rule, cutover old-growth ponderosa pine

Board feet inside bark
Merchantable stem excluding stump and top

Top diameter variable
Stump height 1.0 foot

DBH class (Inches)	Number of merchantable 16-foot logs										Basis: Trees
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
Midpoint at half-inch:[1]	- - - - - - - - - - - Volume in board feet - - - - - - - - - -										Number
11.5	16	31	47	63							3
12.5	19	37	56	74	92	110					20
13.5	22	44	65	86	107	129	150				15
14.5	25	50	75	99	124	148	173				49
15.5	29	57	85	113	141	169	197				35
16.5	33	65	96	128	160	192	224	256			70
17.5	37	72	108	144	180	216	252	287			94
18.5	41	81	121	161	201	241	281	321	361		94
19.5	43	90	134	179	223	268	312	357	401		94
20.5	50	99	148	197	247	296	345	394	443		102
21.5	55	109	163	217	271	325	379	433	487		68
22.5	60	119	178	238	297	356	415	474	534		89
23.5	65	130	195	259	324	388	453	517	582		52
24.5	71	141	211	282	352	422	492	562	632		44
25.5	77	153	229	305	381	457	533	609	685	761	32
26.5		165	247	329	411	493	576	658	740	822	31
27.5		178	266	355	443	531	620	708	797	885	22
28.5		191	286	381	476	571	666	761	855	950	6
29.5			306	408	510	611	713	815	916	1018	2
30.5			327	436	545	653	762	871	980	1088	4
31.5				465	581	697	813	929	1045	1161	4
32.5				495	618	742	865	989	1112	1236	1
33.5				526	657	788	919	1050	1182	1313	2
34.5				557	697	836	975	1114	1253	1392	2
35.5				590	738	885	1032	1179	1327		0
36.5				624	780	935	1091	1247	1403		1
37.5				658	823	987	1152	1316	1480		2
38.5					867		1214	1387	1560		1
Basis: No. trees	8	57	145	270	213	150	57	35	3	1	939

Block indicates extent of basic data.
Derived from $V = 0.8969 + 0.2338\ D^2H$.
Standard error of estimate = ± 27.19 percent.
[1] Diameter class breaks at full inch: e.g., 20-inch class includes 20.0 to 20.9.

Table 4.--Gross scaled volumes in cubic feet, cutover
blackjack ponderosa pine

Cubic feet inside bark   Top diameter variable
Merchantable stem excluding stump and top Stump height 1.0 foot

DBH class (Inches)	Number of merchantable 16-foot logs							Basis: Trees
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	
	- - - - - - - - - Volume in cubic feet - - - - - - - - -							Number
Midpoint at full inch:[1]								
11.0	5	8	10	13	15	18	20	193
12.0	6	9	12	15	18	20	23	182
13.0	6	10	13	17	20	23	27	104
14.0	7	11	15	19	23	27	31	63
15.0	8	12	17	21	26	30	35	35
16.0	8	13	18	24	29	34	39	19
17.0	9	15	20	26	32	38	44	15
18.0	10	16	23	29	36	42	49	10
19.0		18	25	32	39	47	54	3
20.0		19	27	35	43	51		1
21.0		21	30	39	47			1
22.0			32					0
Midpoint at half-inch:[2]								
11.5	6	8	11	14	16	19		86
12.5	6	9	12	16	19	22	25	206
13.5	7	10	14	18	21	25	29	138
14.5	8	12	16	20	24	28	33	88
15.5	8	13	18	22	27	32	37	45
16.5	9	14	19	25	30	36	41	25
17.5	9	15	22	28	34	40	46	20
18.5	10	17	24	31	37	44	51	8
19.5	11	18	26	34	41	49	57	8
20.5		20	28	37	45	54		0
21.5		22	31	40	50	59		2
22.5			34		54			0
Basis: No. trees	3	100	254	197	61	10	1	626

Block indicates extent of basic data.
Derived from $V = 3.0618 + 0.0402\ D^2H$.
Standard error of estimate = ± 30.30 percent.
[1]Diameter class breaks at half-inch: e.g., 20-inch class includes 19.6 to 20.5.
[2]Diameter class breaks at full inch: e.g., 20-inch class includes 20.0 to 20.9.

<p style="text-align:center">Table 5.--Gross scaled volumes in cubic feet, cutover old-growth
ponderosa pine</p>

Cubic feet inside bark   Top diameter variable
Merchantable stem excluding stump and top   Stump height 1.0 foot

DBH class (Inches)	Number of merchantable 16-foot logs										Basis: Trees
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
Midpoint at full inch:[1]	‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ Volume in cubic feet ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒ ‒										Number
11.0	10	12	14	17	19						10
12.0	10	13	16	18	21	24					19
13.0	11	14	17	20	24	27					34
14.0	11	15	19	22	26	30	34				38
15.0	12	16	20	25	29	33	38	42			49
16.0	12	17	22	27	32	37	42	47			80
17.0	13	18	24	30	35	41	46	52	58		102
18.0	14	20	26	32	39	45	51	57	64		101
19.0	14	21	28	35	42	49	56	63	70		105
20.0	15	23	31	38	46	54	61	69	77		71
21.0	16	24	33	41	50	59	67	76	84		88
22.0	17	26	35	45	54	63	73	82	92		59
23.0	18	28	38	48	58	69	79	89	99		52
24.0	18	30	41	52	63	74	85	96	108	119	45
25.0		31	44	56	68	80	92	104	116	128	25
26.0		33	47	60	73	86	99	112	125	138	27
27.0		36	50	64	78	92	106	120	134	148	13
28.0			53	68	83	98	114	129	144	159	2
29.0			56	72	89	105	121	137	154	170	2
30.0			60	77	94	112	129	147	164	181	6
31.0				82	100	119	137	156	175	193	2
32.0				87	106	126	146	166	186	205	3
33.0				92	113	134	155	176	197	218	2
34.0				97	119	142	164	186	209		0
35.0				102	126	150	173	197	221		1
36.0				108	133	158	183	208	233		1
37.0					140	166	193	219	246		2
38.0								231			0
Basis: No. trees	8	57	145	270	213	150	57	35	3	1	939

Block indicates extent of basic data.
Derived from V = 7.3073 + 0.0387 D^2H.
Standard error of estimate = $\pm$18.69 percent.
[1]Diameter class breaks at half-inch: e.g., 20-inch class includes 19.6 to 20.5.

Table 6.--Gross scaled volumes in cubic feet, cutover old-growth
ponderosa pine

Cubic feet inside bark   Top diameter variable
Merchantable stem excluding stump and top   Stump height 1.0 foot

DBH class (Inches)	Number of merchantable 16-foot logs										Basis: Trees
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
Midpoint at half-inch:[1]					Volume in cubic feet						Number
11.5	10	12	15	18							3
12.5	10	13	16	19	22	25					20
13.5	11	14	18	21	25	28	32				15
14.5	11	15	20	24	28	32	36				49
15.5	12	17	21	26	31	35	40				35
16.5	13	18	23	28	34	39	44	49			70
17.5	13	19	25	31	37	43	49	55			94
18.5	14	21	27	34	40	47	54	60	67		94
19.5	15	22	29	37	44	51	59	65	74		94
20.5	15	24	32	40	48	56	64	72	80		102
21.5	16	25	34	43	52	61	70	79	88		68
22.5	17	27	37	46	56	66	76	86	95		89
23.5	18	29	39	50	61	71	82	93	103		52
24.5	19	31	42	54	65	77	89	100	112		44
25.5	20	32	45	58	70	83	95	108	121	133	32
26.5		34	48	62	75	89	102	116	130	143	31
27.5		37	51	66	80	95	110	124	139	154	22
28.5		39	54	70	86	102	117	133	149	164	6
29.5			58	75	92	108	125	142	159	176	2
30.5			61	79	97	115	133	151	169	187	4
31.5				84	103	123	142	161	180	199	4
32.5				89	109	130	150	171	191	212	1
33.5				94	116	138	159	181	203	224	2
34.5				99	122	145	169	192	215	238	2
35.5				105	129	154	178	202	227		0
36.5				110	136	162	188	214	239		1
37.5				116	143	171	198	225	252		2
38.5					151		208	237	265		1
Basis: No. trees	8	57	145	270	213	150	57	35	3	1	939

Block indicates extent of basic data.
Derived from V = 7.3073 + 0.0387 D^2H.
Standard error of estimate = $\pm$18.69 percent.
[1]Diameter class breaks at full inch: e.g., 20-inch class includes 20.0 to 20.9.